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DETERMINATION OF BROWSE INTAKE AND NUTRIENT DIGESTIBILITY OF GRAZING WEST AFRICAN DWARF (WAD) GOATS FED VARYING LEVELS OF *Gmelina arborea* LEAVES AS SUPPLEMENTS IN DELTA STATE NIGERIA

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ABSTRACT

The Research was carried out to assess the browse intake and nutrient digestibility of grazing West African Dwarf (WAD) goats fed varying levels of *Gmelina arborea* leaves as supplement. Which produces appreciable amount of forage even at the peak of the dry season in the tropics, thereby ensuring all year round supply of foliage and fodder. Thirty growing West Africa Dwarf (WAD) goats were used to determine the level of browse intake and nutrient digestibility by goats fed varying levels *Gmelina arborea* leaves as supplement. The goats were randomly divided into five groups of six animal per group. Goats in Treatment A were fed commercial growers mash, at 0.50 kg, Treatment B were fed 0.25 kg of Gmelina arborea leaves, Treatment C were fed 0.50 kg of Gmelina arborea leaves, Treatment D 0.75 kg and Treatment E 1.00 kg of *Gmelina arborea* leaves. Data were collected for thirteen weeks on browse intake and nutrient digestibility. Chemical analysis showed significantly ($p<0.05$) higher crude protein and lower crude fibre content in Gmelina arborea leaves than both grass *Pennisetum purpurem* and growers mash. The values observed for growers mash for Nitrogen free extract and ether extract were higher than those observed in *Gmelina arborea* leaves and elephant grass. Significant differences ($p<0.05$) existed for values recorded by the goats fed the different experimental diets. Goats fed Diet E had the highest ($p<0.05$) browse intake than Goat fed Diet D and C. Goat fed Diet B recorded the least significant ($p<0.05$) quantity of browse intake. Dry matter digestibility values as well as the crude protein digestibility were appreciably high for all animal fed the experimental diets. The goats fed diet E had the highest crude fibre digestibility followed by goats fed diet A and that of D, B and C respectively. Therefore, the study suggested 0.5 kg inclusion of *Gmelina arborea* leaves in the diet of grazing WAD goats as the optimum level for better performance.

Keywords: *Browse intake, determination, grazing, goat, Gmelina arborea, nutrient digestibility, supplements*

INTRODUCTION

The problem of seasonal fluctuation in both quality and quantity of animal feed in the tropics calls for exploration of some variety of multipurpose tree and shrubs abundant all the year round in the region in order to determine their suitability for livestock feeding. Due to the non availability of pasture lands, more attention is now being given to tree leaves and shrubs for feeding sheep and goats in most areas of the World (Ayuk *et al,* 2007). In Nigeria, heavy weight loss and high mortality in goat due to lack of forage during the dry season are common in livestock farms. Multipurpose trees and shrubs fodders are important feed resources for bridging the seasonal deficit in feed quantity and quality (Okagbare *et al.,* 2005a, b). One of the modification strategies advocated for the typical free roaming characteristics of animals in the traditional system is the tethering feeding method which confines the animals within a restricted location for grazing (Qtchere and Kallah, 1990). Available information by Ogebe (2000) and Ogebe *et al*. (1999) indicates that the tethering feeding system is used to restrain the animals to avoid crop damage. Francis (1988) reported that some flocks were controlled by tethering to avoid crop damage during the cropping season in South East Nigeria. Adoeye (1984) reported that small ruminant production has been integrated with alley cropping by cut and carry feeding of a portion of the tree foliage, or at a some what, higher management level, by grazing the natural fallow re-growth and tree during periodic fallow years. Okagbare *et al.* (2004) showed that *Gmelina arborea* leaves are rich source of protein with high content of protein (22.29%) and high ash (6.28%). This high nitrogen content of these tree species contributes to improving the nutritional quality of the diet of grazing ruminants (Adoeye, 1984).

Osakwe and Smith (2004) reported that there have been few grazing trials in the country to determine productivity of pasture and small ruminant performance, they suggested the planting of browse species such as *Leucaena leucocephala*, *Gliricidia sepium* and *Gmelina arborea* as hedgerows of alleys in native or productive permanent grass species may overcome the constraint to animal production caused by lack of fodder in the dry season.

Sansacy and Emery (1982) suggested that in order to reduce competition between man and livestock for feeding stuffs, non conventional feed ingredients should be exploited and used for livestock feeding. Hence, this study is aim at evaluating browse intake and nutrient digestibility of WAD goats.

MATERIALS AND METHODS

The study was conducted at the Goat unit of the Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture, Delta State University, Asaba Campus. Delta State falls within the humid tropics of Nigeria and Asaba precisely lies between Longitudes 6 °E and 8 °E and Latitudes 06 °49 North of the Equator. Asaba has its raining season from March to September with a mean annual rainfall of 1500-1849.3 mm. It has a moderate climate with very high temperature during the dry season (October-February) with its mean annual temperature and precipitation of 28°C±6°C and 117 mm, respectively Asaba metrological station 2011.

Experimental animals: Thirty growing male and female West African Dwarf goats of 6-11 months of age, weighing 12 -22.5 kg were used for the study and it was verified by using the dentition estimation method (Sastry and Thomas, 1980). The goats were individually divided into five groups of six goats per treatment (one per replicant). Groups A were fed commercial growers mash at 0.50 kg/goat, group B were fed *Gmelina arborea* leaves at 0.25 kg/goat, group C were fed 0.50 kg/ goat, while group D were fed 0.75 kg/ goat and group E were fed *Gmelina arborea* leaves at 1.00 kg/goat.

The *Gmelina arborae* leaves were harvested fresh without regards to the age of the leaves and offered to goats. Prior to serving new feed and water, the remnant of the Gmelina arborea leaves in each pen was weighed daily before washing and dissecting the pen floor.

At 9am hour every day the goats were taken out for grazing in the paddock. After grazing for five hours daily the goats were brought back to their treatment pens. The feeding trial lasted for 90 days. Weighing was done once a week in the morning before they were taking out for grazing.

The goats were generally observed during the feeding trial and the quality of the daily feeds provided for each animal was recorded, while remnants of the previous day feed were individually weighed to determine the daily feed intake of each animal.

DATA COLLECTION AND ANALYSIS

Data were collected on feed intake; feed intake was calculated as the difference between amount of feed served daily and the leftover as the trial lasted. The goats weighed individually once a week, to determine the live weight change. The samples or experimental diets were collected during the experiment for Dry Matter (DM) determination and chemical analysis. The samples were weighed and dried and then stored for

proximate and fibre component analysis. At the 13m week of the study four animals from each experiment group were selected and place in metabolic cages to determine the nutrient digestibility of the goats. Samples of feeds were analyzed for their proximate composition using the procedures of the AOAC (1990). Data generated were analyzed using SAS Institute (1985) and treatment mean were separated using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The results of the chemical composition of *Gmelina arborea* leaves, *Pennisetum purpureum* and growers mash are shown in Table 1. The crude protein content of *Pennisetum purpureum* (11.38%) and growers' mash (16.63%) recorded lower values compared with *Gmelina arborea* leaves (19.26%). The values observed for crude fibre were significantly ($p<0.05$) higher for *Pennisetum purpureum* (24.00%) than values recorded for Gmelina (11.00%) and growers mash (7.50%).

The values recorded for growers mash for nitrogen free extract (58.71%) and ether extract (2.00%) were higher ($p<0.05$) than those observed in *Gmelina* for nitrogen free extract (12.84%) and ether extract (0.50%), while the values observed for elephant grass for nitrogen free extract (10.91%) and ether extract (1.00%) were lower ($p<0.05$). The energy content of feeds was determined using the ballistic bomb calorimeter.

Table 2 shows the values recorded for the weekly browse intake (on dry matter basis) by the grazing goats fed varying levels of *Gmelina arborea* leaves. Significant differences ($p<0.05$) existed among values recorded for the average weekly browse intake. Goats fed diet E (1.00 kg) *Gmelina arborea* leaves had the highest ($p<0.05$) browse intake with average daily.

Table 1: Chemical composition (%) of experimental diet

Nutrients	*Gmelina* leaf	Elephant grass	Growers mash
Dry matter	52.75	60.62	90.84
Crude protein	19.26	11.38	16.63
Crude fibre	11.00	24.00	7.50
Ash	9.15	13.33	6.00
Ether extract	0.50	1.00	2.00
Nitrogen free extract	12.84	10.91	58.71
Neutral detergent fibre	59.72	68.14	Not determined
Acid detergent fibre	41.28	47.26	Not determined
Gross energy (kcal/g Dm)	3.05	3.65	3.95

Table 2: Shows the browse intake of grazing WAD goats fed varying levels of *Gmelina arborea* leaves as supplement

Gmelina arborea leaves (kg)						
	Control and growers mash					
Weeks	TA	TB	TC	TD	TE	S.E.
1	2.80b	1.52b	2.35b	4.57“	6.13“	0.48
2	2.80b	1.72c	2.33b	4.55a	4.72“	0.33
3	2.62b	1.70c	2.62b	4.70“	4.84“	0.35
4	2.40b	1.58b	1.88b	3.55“	3.80“	0.26
5	2.32b	1.63°	2.63b	4.22“	4.58“	0.31
6	2.07b	1.97“	2.33ab	3.80“	3.12ab	0.27
7	2.03b	1.75b	2.33b	3.98“	3.90“	0.29
8	2.22b	1.75b	2.43b	4.62“	5.27“	0.39
9	1.72b	1.75b	2.23b	4.43“	4.43“	0.36
10	2.35b“	1.75“	2.83b	5.12“	5.43“	0.41
11	2.57b“	1.70°	2.95b	4.92“	4.98“	0.37
12	1.95bc	1.63“	2.17b	5.12“	4.67“	0.39
13	2.3 8C	1.75°	2.98c	4.85“	3.98“b	0.34

Within each row, means with different superscripts are significantly different ($p<0.05$) a,b,c; TA = Treatment A (0.50 kg commercial grower mash; TB = Treatment B (0.25 kg *Gmelina arborea* leaves supplementation); TC = Treatment C (0.50 kg *Gmelina arborea* leaves supplementation); TD = Treatment D (0.75 kg *Gmelina arborea* leaves supplementation); TE = Treatment E (1.00 kg Gmelina arborea leaves supplementation); WAD = West African Dwarf goat SE = Standard Error as control)

Table 3: Nutrient digestibility (%) by grazing WAD goats fed varying levels of *Gmelina* leaves as supplements

Parameters	A feeds	B 25%	C 50%	D75%	E 100%	SEM
Dry matter	76.1	71.1“	76.5“	78.6’*	74. lb	1.90
Crude protein	83.1“	73.2bc	70.4“	70.8ab	74.1“	2.73
Crude fibre	69.0b“	55.1“	46.6“	66.8b	73.5b“	2.80
Ether extract	69.3C	67.7“	33.0b	22.lb	10.3“	2.90
Nitrogen free extract	60.0“	26.6b	32.2b“	45.2b	14.3“	2.70
Acid detergent fibre	-	82.2“	80.4“	88.4“	85.2“b	0.71
Neutral detergent fibre	-	79.4b	79.4b	48.6“	76.6*	1.20

a, b, c, d values on the same row with identical superscript are not significantly ($p>0.05$) different

browse intake of 0.88 kg per animal than goat fed treatment D. diet, (0.75 kg) *Gmelina arborea* leaves with average daily browse intake of 0.65 kg per animal. However, they recorded average weekly total browse intake of 3.98 kg per animal in group E and 4.88 kg per animal in group D. While the goats fed diet C (0.50 kg) *Gmelina arborea* leaves recorded

average daily browse intake of 0.34 kg per animal with average weekly total browse intake of 2.98 kg per animal. But goats fed diet B representing (0.25 kg) *Gmelina Arborea* leaves recorded the least ($p<0.05$) quantity of browse intake with average daily browse intake of 0.22 kg per animal and average weekly total browse intake of 1.75 kg per animal.

The goats fed diet A (0.50 kg) commercial growers mash recorded average daily feed intake of 0.40 kg per animal with average weekly total feed intake 2.38 kg per animal during the experimental period.

The results of nutrient digestibility are presented in Table 3. The dry matter digestibility as well as the crude protein digestibility was appreciably high for all the experimental animals. Goats in treatment B had a mean crude protein digestibility of 73.20%. Goat in treatment D had 70.80%, followed closely by goats in treatment C with mean crude protein digestibility of 70.40%. Goats in diet A recorded higher ($p<0.05$) crude protein digestibility.

The group fed with diet E had highest crude fibre digestibility value of 73.50%, followed by those fed on diets A, (69.00%) and that of D (66.89%), B (55.10%) and C (46.60%) respectively. The goats on diet C had the highest N-intake of 24.70g/day followed by those on diets C (23,OOg/day), D (19.2 oglday), B (1 2.90 g/'day) and A (1 2.6 oglday), respectively.

Browse plants as excellent fodder are generally richer than grasses in protein and minerals, although information on their chemical compositions is scanty. Recently the use of browse plant supplementation with grasses has however assumed great importance in the tropics.

Gmelina arborea leaves used in this study, showed premiss as feed for goats, due to the high crude protein content. The crude protein value 19.26% obtained in *Gmelina leaves* in this study is comparable with previously reported values by earlier workers (Okagbare et al., 2004; Onabarijo and Onwuka, 1998). The crude protein of *Gmelina arborea* leaves obtained in this study is similar to crude protein content values reported for other browse plants such as Albizia Iebbeck -22.3, *Gliridia sipum* 24.7, *Leucaena leucocephala* 23.8, *Parkia biglobosa* 17.9, *Interolibium cyclocarpum* 19.0 and *Verminia guoygdalina* 29.1 (Babyemi *et al.*, 2005). The crude protein value in this study also compares favourably with the crude protein values of some foliage crops that have been evaluated and integrated into ruminant feeding. They include *Bamibpsa vulgaris*, 22.38%, *Mangefera indica* 15.13% and *Newbouldia leavis* 15.57% respectively by Ikhimioya (2005).

This high crude protein in the diets has been considered as an important factor in ruminant's diet because free choice intake of feed by animals is increased by the increase in crude protein content of the diet.

The value of 19.26% crude protein in this present study was far above 7% recommended for tropical . vestock by Minson (1990) below which there will be a deficiency in performance. The crude protein of dmelina in this study is also higher than those reported by Okagbare and Brattle (1999) for the leaves of *Parkia fdicoidea* and by Gall (1981) for the leaves of *Opunita ficnsindica, Opunita linduelmeri, Opunita enjelami*. The crude protein obtained in this study are also higher than other browse plants reported by Babyemi *et al.* 2005), for *Acacia ferrimginea* (14.0), *Acacia fistula* (12.9), *Feltophorum pheracarpum* (11.6) and *Albizia samen* (11.2). The crude protein and the ash content in this study is higher than that of the control diet ' treatment A) which makes the plants under study -Cher in minerals and vitamins and serves as complete fodder for livestocks.

It is quite obvious that the browse plant under study (*Gmelina arborea*) has a high potential compared to other available browse plants, as sources of feed supplement for ruminants with regards to their chemical compositions, most especially the high crude protein levels. This is of great importance in helping to checkmate the problem of weight loss in ruminant livestock management which is common during the dry season, when the quality of available grasses would have dropped drastically.

As shown in Table 2 significant differences ($p<0.05$) existed among values recorded for the average weekly browse intake. Goats on diet B (0.25 kg) *Gmelina* leaves recorded the least quantity of browse intake 1.75 kg per animal. This agrees with earlier works of Ademusum *et al.* (1985) and lfut (1992) that when the proportion of *Panicum maximum* in the diet of Gliricidia was increased, dry matter digestibility fell. This is as a result of inadequate supplementation of the browse leaves in this study; goats on this treatment were not getting enough Gmelina leaves supplementation. This in turn slow their growth rate/weight increase reported by Castillo *et al*. (2001) that, average daily weight gain was affected by protein- energy levels in the diets. The tendency for lower growth rate at each level of protein supplementation could be due partly to low intake of energy. However, goats on diet C (0.50 kg) Gmelina arborea leaves recorded average weekly total browse intake of 2.98 kg per animal.

As reported by the Agricultural Research Council (ARC, 1985) that the presence of a fermentable energy source in the diet allows high nitrogen feeds such as Gliricdia and Leucanna to

be utilized more efficiently, the optimum level of *Gmelina arborea* leaves 0.50 kg supplementation in this study was well utilized by the goats. The browse intake in this diet was absolute, goats were gaining weight, dry matter digestibility was high compare to diet B in supplementation of diet C at this level of 0.50 kg intake of *Gmelina arborea* leaves which represent the optimum level of browse intake to grazing goats in this study compared favourably with report of *Gmelina arborea* leaves as reported earlier by Okagbare *et al.* (2004); They stated that when Gmelina arborea leaves was supplemented with *Panicum maximum* and *Pennise.tum purpureum* with the browse constituting 50-52% of total dry matter intake, weight gain was enhance by the goats. In a similar study with other browse plant (Aina, 1998) reported that Tephrosial induces better weight gain and feed conversion efficiency in sheep and goat in Tephrosial elephant grass mixture.

Goats fed diet E 1.00 kg *Gmelina arborea* leaves had the highest ($p<0.05$) browse intake with average weekly total browse intake of 3.98 kg per animal, than goat fed group D diet 0.75 kg Gmelina leaves with average weekly total browse intake of 4.88 kg per animal. Goats on this treatment have the highest browse intake but they consistently lost weight. This is in agreement with Okagbare and Bratte (1999) which stated that though the dry matter intake by goats fed *Gmelina* leaves was high, the goats consistently lost weight, which then attributed to inadequate energy intake of goats fed Gmelina leaves. In earlier studies, higher level of browse intake as reported by Akingbade *et al.* (2004) stated that the sole use of *Gliricidia setium* was responsible for the lower overall weight loss of goats, which agrees with the trend also observed for goats fed 1.00 kg and 0.75 kg *Gmelina arborea* leaves inclusion in the diet used in this study in which all the goats lost weight.

The works of Aina (1998) and Bamikole and Babayemi (2004) further stressed the effect of high level of browse leaves in goats diets which the findings of this study confirmed. They had reported that none of the Multipurpose Trees and Shrubs (MPTS) may be able to Support a profitable goat production when used as a sole feed, because at this high level of browse intake, there was always a weight loss in all the experimental animals, which agrees with the findings on goats fed treatments E and D in this study where all the animals lost weight consistently. However, they suggested that multipurpose trees and shrubs will be more profitably utilized as supplements at a reduced level of inclusion in animal diets, but they did not establish their fact with any optimum level.

This study, therefore established the optimum level of 0.50 kg of Gmelina arborea leaves (browse intake) supplementation to adult grazing goats, were all treated animals gained weight at a total average weekly weight of 1.13 kg at the end of the experiment.

The digestibility values as shown in Table 3 were fairly high in all the treatments. This high level of dry matter (76.50%), ether extract (33.00%) and nitrogen free extract (32.20%) digestibility by goats in treatment C (0.50 kg) Gmelina arborea leaves enhanced the performance of goats on this treatment inspite of the. high crude protein digestibility recorded (70.40%).

The high ash content of *Gmelina arborea* leaves in this study 9.15% is comparable with report from earlier study by Okagbare *et al.* (2004). This high content of dry matter, crude protein and energy content suggests that *Gmelina arborea* leaves may serve as a complete fodder for livestock because they are rich in protein and minerals. This high nutrient content digestibility is in agreement with earlier study by Ayoade *et al.* (1998) that the nutrients of the leaves of Tephrosia braceteolata were highly digestible and resulted in some appreciable live weight changes of 0.047 kg/day. While in a *Panicum maximum* plus Gliricidia diet, dry matter digestibility fell as the proportion of *Panicum maximum* in the diet increased Ademusum *et al.* (1985) and Ifut (1992). This implies that there must be an optimum level of browse/grass supplementation which this study tend to address, that for adult grazing goats 0.50 kg *Gmelina* leaves is the optimum to be fed on daily basis as supplement. The weight lost as stated by Okagbare and Bratte (1999) was due to inadequate energy intake by goats. The presence of a fermentable energy source in the diet allows high nitrogen feed such as Gliricidia and Leucaena to be utilized more efficiently, (Agricultural Research Council, 1985).

Based on these experiments, a small amount of sun dried cassava peels (50 g/day) could be ideal as a supplement to G*liricidia and Leucaena* which is in agreement with the optimum level of 0.50 kg of *Gmelina arborea* leaves in this study. However certain inherent substances in many of the browse trees limit their use as forage for ruminants when they exceed threshold levels (Jabbar *et al.,* 1997).

Poppi and McLennan (1995) reported that protein- rich supplements cannot be effectively utilized in the rumen when energy sources are not available. In addition, Castillo *et al.* (2001) reported that average daily weight gain is affected by protein - energy levels in diets and the tendency for lower growth rate at each level of protein supplementation is due partly to low intake of energy. The finding of this study, for goats fed at 0.75 kg and 1.00 kg although had high protein digestibility, but all goats

lost weight consistently. These findings may therefore be attributed to probable inadequate protein energy balance in these diets, this corroborating the reports of Poppi and McLennan (1995) and Castillo *et al.* (2001).

CONCLUSION

The result of this study showed that Gmelina arborea leaves when fed as supplement to grazing goats will improve the dry matter intake and nutrient digestibility of goats. This study also suggested 0.50 kg of *Gmelina arborea* leaves in the diet of grazing goats as the optimum, were all the animal were gaining weight.

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